A New Alternative for Relativity Theory

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Abstract

This paper introduces a new approach to relativity; a non-equivalent alternative, explains the same phenomena discussed by Special and General Relativity. This approach is based on the famous mass energy equation as the main postulate as well as the relativity principle and a new theoretical intuitive definition for Kinetic Energy. Then, by using pure mathematical methods, it explains clearly the phenomenon of the fixed speed of light in different inertial frames of reference, as well as those of non-accelerated light when moving toward, or away from a mass, the bending of light near masses and the additional perihelion advance in astronomic objects' orbits. Results do not match perfectly those predicted by General or Special Relativity. However, the known experiments results do not agree with the classical relativity theories more than they do with this study.

1 Introduction

The famous equation $E = mc^2$ is very simple and general. E is the energy of some physical system, m is its mass, and c^2 is the constant squared speed of light. This equation states that the quantity of material (mass) is equivalent to the quantity of life (energy). In fact, we can apply similar equations to a very wide range of subjects, for instance in economics, where the value of a company (financial mass) depends completely on its actual and predicted profits (financial life or energy). Therefore, this is really a philosophical principle, not just a physical one.

Searching for references for a philosophical essay, I expected to find many articles showing how all aspects of relativity can be concluded directly or indirectly from this basic equation. It turned out that this is not an easy or common subject, and it requires a reconsideration of the whole theories of relativity.

2 Mass and Energy

2.1 *The Mass-Energy Equation*

Let us first look to this equation $E = mc^2$. c^2 here is just a constant value that depends completely on the physical unit system. Why is it equal to the squared speed of light? This is simply because the unit of energy was considered for a very long time proportional to the squared unit of speed. We can eliminate this value from the equation by choosing a suitable unit system obtainable by dividing the unit of energy by the squared speed of light and dividing the unit of speed by the speed of light. Then, the speed of light becomes 1. In this paper, unless otherwise stated, a unit system is used where speed of light is 1.

I do not think mass is an ambiguous thing at all, rather, it is the easily measurable quantity of material e.g. by using balances. On the contrary, energy is not an obvious term and no tool to measure it directly is available.

2.2 *The Definition of Energy*

If we accept that energy is life (as we may assume here), we can say that energy is proportional to speed, since speed is proportional to life, i.e. a static thing is not alive, and when its movement increases (speed), we say it gains more life.

If two cars move in one direction, then the system of the two cars has more life than another system, consisting of just one car. Therefore, life is proportional also to the amount of material i.e. mass.

Thus, we can give this definition for energy:

$$E = m|v|$$

Where *m* is the mass of a moving object, *v* its speed and *E* the energy resulting from object's movement. I write velocity here as an absolute scalar value (speed), not a vector, since energy and mass are scalar and the amount of life is not related to the direction of movement.

We will call this energy, which is related to speed and mass, *Kinetic Energy*, giving it the symbol E_k. This looks like a new definition, which differs from the commonly known one $E_k = ½mv^2$, to be discussed more deeply later.

As is well known, no object can be considered truly solid, since every material object consists of numerous minute molecules, atoms, and particles that are always in motion. Thus, every material object is, in fact, alive in a sense, and has life we may call *Internal Energy,* giving it the symbol E_I. Hence, the total energy of a system can be calculated as follows:

$$E = E_k + E_I = m|v| + E_I$$

This is a definition, a new one, not a law.

2.3 *Mass-Speed Relation Equation*

Since energy is just another facet of mass, we can define m_I as the *internal mass* of object (not to be confused with *inertial mass*) which equals E_I, therefore:

$$E = m|v| + m_I$$

In addition, by applying the mass – energy equation another time but on E, we get:

$$m = m|v| + m_I$$

The equation above may be called *mass-speed relation* equation.

According to Special Relativity, the equation called *energy-momentum relation* is:

$$E^2 = p^2 + m^2$$

Where E is the total energy of the system, p is the momentum of a moving body and m is the rest mass (Okuň, 2009).

The *Relativistic Mass* principle, the mass of the moving body, which is not widely used and accepted (Okuň), equals the total energy of the system (when the speed of light is 1), and momentum is the product of mass and velocity. Therefore, the *energy-momentum relation equation* can be expressed as follows:

$$m^2 = m^2v^2 + {m_I}^2$$

Thus, the only difference between the latter equation and the former is that all the parts of the latter are squared, as Einstein and other Relativity theorists used the common kinetic energy definition $E_k = ½mv^2$, considering it a good approximation, when speed is much slower than the speed of light (Okuň), which can be explained as follows:

$$m = E = E_k + E_I = ½m_I v^2 + m_I = m_I(1 + ½v^2)$$

$1 + \frac{1}{2}v^2 \approx \frac{1}{\sqrt{1-v^2}}\ when\ |v| \ll 1$. Therefore, it follows that:

$$m = \frac{m_I}{\sqrt{1 - v^2}} \Rightarrow$$
$$m^2 = m^2v^2 + {m_I}^2 \Rightarrow$$
$$E^2 = p^2 + {m_I}^2$$

Here, a major logical problem arises. The total energy formula $E = ½m_I v^2 + E_I = E_k + E_I$ is intuitively recognizable; however, if we consider it as an approximation to the energy–momentum law when speed is much slower than the speed of light, then either the total energy formula does not apply, or the kinetic energy formula becomes overly complicated, as $E_k = \frac{m_I}{\sqrt{1-v^2}} - m_I$. The aim of theoretical science is to explain formulae that are more complex by simpler ones. On the contrary, the formula $E = m|v| + E_I$ is very simple and complies with all the known relativistic phenomena.

2.4 *The Kinetic Energy Common Definition*

A question arises here about the origin and justification of the formula $E_k = ½mv^2$, knowing it was not used by Newton at all, and remarkably, the French philosopher Descartes believed that *Vis Viva* or *Living Force* -the old term for kinetic energy- is as we assume here: $m|v|$ (Ilits, 1971).

Three reasons historically have suggested the use of the formula $E_k = ½\, mv^2$, an experiment devised by Willem Gravesande, Laws of elastic collision and the kinetic–*Potential Energy* equation for an object affected by a gravitational field.

Firstly, Willem Gravesande devised an experiment based on dropping weights from different heights into a block of clay. Gravesande determined that their penetration depth was proportional to the square of their impact speed. Émilie du Châtelet recognized the implications of the experiment and published an explanation saying this is evidence that Vis Viva is proportional to the square of speed (American Physical Society). However, why is the penetration considered proportional to Vis Viva or kinetic energy in the first place? This consideration is unjustified.

Secondly, it is found that, in order to explain the results of an elastic collision, we need both the conservation of the momentum principle, as well as the conservation of the kinetic energy principle.

Suppose we have two objects, *a* and *b*, moving toward each other on a shared straight line, having velocities $\overrightarrow{v_1}$ and $\overrightarrow{v_2}$ before collision, velocities $\overrightarrow{v_3}$ and $\overrightarrow{v_4}$ after collision, and masses m_a and m_b respectively. Then the conservation of momentum can be expressed as follows:

$$m_a v_1 + m_b v_2 = m_a v_3 + m_b v_4$$

While the conservation of kinetic energy can be expressed as:

$$\frac{1}{2} m_a {v_1}^2 + \frac{1}{2} m_b {v_2}^2 = \frac{1}{2} m_a {v_3}^2 + \frac{1}{2} m_b {v_4}^2$$

Effectively, collision does not occur instantly since an infinite repulsion force would be needed; rather, it takes some time. If we take the center of the mass of the system as a reference frame center, then during the collision period there is a moment when both objects are practically static. Here, the question arises: How can kinetic energy be conserved when objects are moving at one moment and stationary at another? It cannot. Evidently, a way to express the conservation of energy is needed, as will be shown later.

Assuming the collision complies with Newton's laws of movement, as if there is a repulsion force causing the two objects to change their directions (which is in fact caused by repulsion forces of objects' atoms' electrons), then the difference in their velocities after collision is opposite to the difference before collision. On a straight line, as viewed by an observer on that same line, we have:

$$v_4 - v_3 = -(v_2 - v_1) \Rightarrow$$
$$v_4 + v_2 = v_3 + v_1 \quad (1)$$

In addition, on a straight line the conservation of momentum would become:

$$m_a v_1 + m_b v_2 = m_a v_3 + m_b v_4 \Rightarrow$$
$$m_b (v_2 - v_4) = -m_a (v_1 - v_3) \quad (2)$$

By multiplying (1) and (2) we get:

$$m_b({v_2}^2 - {v_4}^2) = -m_a({v_1}^2 - {v_3}^2) \Leftrightarrow$$
$$m_a{v_1}^2 + m_b{v_2}^2 = m_a{v_3}^2 + m_b{v_4}^2 \Leftrightarrow$$
$$\frac{1}{2}m_a{v_1}^2 + \frac{1}{2}m_b{v_2}^2 = \frac{1}{2}m_a{v_3}^2 + \frac{1}{2}m_b{v_4}^2$$

Therefore, the so-called conservation of kinetic energy in elastic collision is just a pure mathematical result, which is right only before the collision moment or after it.

Thirdly, the famous *Vis Viva* equation expresses the relation between kinetic energy and the so-called potential energy, where kinetic energy is assumed to be $E_k = ½mv^2$:

$$\frac{1}{2}mv^2 - \frac{Gm\mu}{r} = km$$

Where *m* is the mass of an object orbiting another, *v* is its velocity, relative to the other object, *μ* the sum of the two objects, *G* the gravitational constant, *k* is constant, $\frac{1}{2}mv^2$ the orbiting object's kinetic energy, and $-\frac{Gm\mu}{r}$ its potential energy.

What is the potential energy? The mass–energy equation implies that any energy has a mass, which raises the question, where is the mass of this potential energy? It is non-existent.

This formula is just a mathematical result from Newton's laws of gravitation, an artificial way to say that the conservation of energy principle is correct, even when an object is accelerated, owing to a gravitational force.

Furthermore, certain formulas and terms can be used to justify the common kinetic energy formula e.g. mechanical *work*. These are just definitions.

Hence, the expression $E_k = ½\, mv^2$ does not have a solid basis and is replaceable with the more intuitively recognizable: $E_k = m|v|$.

One may be skeptical about replacing one term with another without experiments. However, the concept of energy is theoretical, rather than concrete, as distance or mass. In the *International System of Units,* where the speed of light does not equal 1, the new kinetic energy formula would be $E_k = mc|v|$, which, most of the time, is enormously greater than $½mv^2$, knowing the correctness of a theoretical quantity depends on the simplification of physical laws, as long as its indirect applications are consistent with experiments results. In addition, much of the experiments made to test Special Relativity are focused on comparing it to Newtonian mechanics, where Special Relativity certainly held its own. To compare our assumptions with Einstein's Special Relativity predictions, tests devised for that specific purpose must be performed.

2.5 *The True Meaning of the Mass-Speed Relation Equation*

The Special Relativity equation $m^2 = m^2v^2 + {m_0}^2$, has always been interpreted based on the understanding that the mass of a system (relativistic mass) increases with the speed of the moving object, while its internal mass remains constant.

Here, using the new mass-speed equation, I will assume the opposite. The total mass (and energy) of the system remains constant and irrelevant to the speed of the object, while its internal mass decreases:

$$m = m|v| + m_I \Rightarrow$$
$$m_I = (1 - |v|)m$$
$$When\ v = 1\ (speed\ of\ light) \Rightarrow$$
$$m_I = 0$$

This assumption complies with the formula $E_k = m|v|$, where *m* is constant. If m_I was the constant, then kinetic energy should be $E_k = m_I|v|$. Additionally, this explains *m*, the constant mass of the system. I note that possible ambiguity and misconception of *relativistic mass* caused this term not to be used widely in Special Relativity.

Moreover, this assumption complies with the conservation of energy principle, as it produces a new formula, stating that both mass and energy are conserved, if no [energy and mass] have been exchanged with outer systems. This is a very general and universal conservation of energy. However, what is called *conservation of energy* in thermodynamics and mechanics can be considered as a result of elastic collision laws.

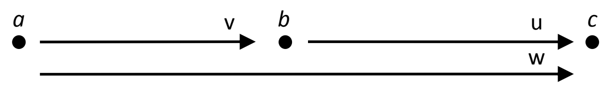
It is noteworthy that this assumption can be tested directly, since Special Relativity predicts that a system weighs more, when heated. On the contrary, we assume that no change in a system's mass will occur unless mass has been exchanged between systems. Has any such experiment taken place? I have not heard of such an experiment.

That said, this equation tells us that a particle having a null internal mass and non-null total mass (and energy) moves always with the speed of light i.e. the photon.

3 Relativistic Velocity

3.1 *Relativistic Speed Addition Formula*

Let us, now, look at a system of three objects, *a*, *b*, and *c*, having the total mass m_a, m_b and m_c respectively. *b* is moving with velocity $\vec{v}$ away from *a*, while *c* is moving with velocity $\vec{u}$ away from *b* on the same line and direction of $\vec{v}$. $\vec{w}$ is the velocity of *c* relative to *a*.



The kinetic energy of c for *a,* is the kinetic energy as a result of its movement relative to *a*, which equals $m_c|w|$. However, if we consider *b* and *c* as one system moving relative to *a* with velocity $\vec{v}$, then, the kinetic energy of *c* for *a* is the sum of its kinetic energy as a result of the movement of the system *bc* relative to *a*, and *c*'s kinetic energy as a result of its movement relative to *b* for *a*.

c's kinetic energy as a result of the movement of the system *bc* for *a* is $m_c|v|$. *c*'s kinetic energy as a result of *c*'s movement relative to *b* for *a* is $m_c|u|(1 - |v|)$. Because the kinetic energy of *c* as a result of its

movement for *b* which equals: $m_c|u|$, is internal in the system *bc* for *a,* then it is considerable as an internal mass and then must be multiplied by the factor $(1-|v|)$ to get its value for an observer staying at *a*.

It follows that:

$$m_c|w| = m_c|v| + m_c|u|(1-|v|) \Rightarrow$$
$$|w| = |v| + |u|(1-|v|) \Rightarrow$$
$$|w| = |v| + |u| - |v|.|u|$$

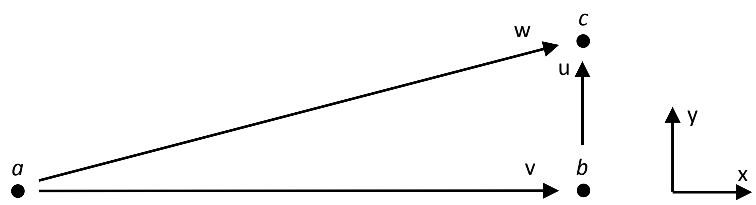
This is the relativity formula of velocity addition regarding new assumptions, or the relativistic speed addition formula, for velocities on same line and direction. It does not look quite new for mathematicians, since similar formulae can be found in the Probability Theory, Sets Theory and -interestingly- Musicology, where the same formula is used to add musical distances, as string fractions on a guitar's string.

If $|u| = 1$ then:

$$|w| = |v| + 1 - |v|.1 = 1$$

This explains why the speed of light is constant in different inertial frames of reference.

If $\vec{v}$ and $\vec{u}$ were perpendicular, then we cannot just add kinetic energies absolute values, instead, we must add them using the vector addition methods as we add vector velocities. Thus, in this case if we use Cartesian coordinates with the x-axis parallel and of direction of v and the y-axis parallel and of same direction of u, we get:

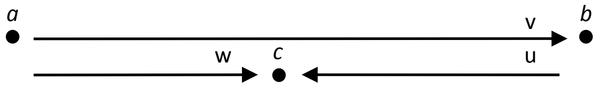


$$m_c|w_x| = m_c|v_x| + m_c|u_x|(1-|v|) \Rightarrow$$
$$|w_x| = |v|$$
$$m_c|w_y| = m_c|v_y| + m_c|u_y|(1-|v|) \Rightarrow$$
$$|w_y| = |u|(1-|v|)$$
$$\Rightarrow \vec{w} = \vec{v} + \vec{u}(1-|v|) \Rightarrow$$
$$w^2 = v^2 + u^2(1-|v|)^2$$

Note that in both vertical and horizontal equations we multiply the kinetic energy between *b* and *c* by $(1-|v|)$, because we consider it as an internal mass in the system *bc*, a mass which is moving in speed $|v|$ relative to *a*.

When $\vec{u}$ and $\vec{v}$ have opposite directions on same line, assuming $|v| > |u|$, then we cannot just add the kinetic energies as we did when velocities were on same direction, since the movement of *c* relative to *b* in

fact decreases the kinetic energy of the system *bc* for *a*. It is rather hard to obtain the addition formula in this case directly; therefore, we will use an easy indirect method:



$$|v| = |w| + |u| - |w|.|u| \Rightarrow$$
$$|v| = |w|(1 - |u|) + |u| \Rightarrow$$
$$|w| = \frac{|v| - |u|}{1 - |u|} = |v| - |u|\frac{1 - |v|}{1 - |u|}$$

In all the three cases studied above, the amount of speed between *b* and *c* for *a*, if measured by an observer placed at *a,* is less than its amount if measured by an observer at *b* or *c*. In the first and second cases, it is multiplied by $(1 - |v|)$ (< 1), and in the third case, is multiplied by $\frac{1-|v|}{1-|u|}$ (< 1).

The speed of a satellite with a circular orbit can be exactly calculable based on its mass and distance from the Earth's center of mass and the mass of the Earth. In fact, any observer can calculate this very speed, since it depends completely on the gravitational acceleration and distance that have absolute, rather than relative values. Even an observer inside that satellite can calculate this velocity, which is tangential relative to the Earth's center of mass.

Here arises the need to distinguish between two types of velocity, observed speed, and locally-known speed. Satellite observed speed for an observer sitting inside it, is null; however, its locally-known speed is its absolute tangential speed around the Earth. At any time, the locally-known speed can be considered null, but when acceleration occurs, then the local known speed shall be reconsidered and calculated. Of course, this does not require awareness, or a memorable knowledge by the observer himself, but rather by a physicist, studying the case.

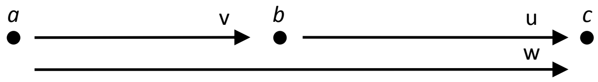
Therefore, the kinetic energy of the satellite based on its tangential velocity is not relativistic, nor is its internal mass. Therefore, the internal velocities between the parts of this satellite are the same for any observer i.e. if $\vec{v}$ and $\vec{u}$ were both tangential relative to *a*, then they can be added normally using traditional Euclidean methods.

3.2 *Rapidity*

Rapidity, a term already in use in Special Relativity, denotes a virtual velocity that can be dealt with in the same way as classical mechanics would deal with velocity. That means rapidity inside a system does not decrease, due to system rapidity relative to an outer observer. Therefore, two rapidities can be added using traditional vectors addition method to get a third rapidity.

Using polar (or spherical) coordinates centered at an observer's place, the relativistic radial speed addition formula, as we have already concluded is:

$$|w| = |v| + |u| - |v|.|u| \Leftrightarrow$$
$$(1 - |w|) = (1 - |v|)(1 - |u|)$$



A given multiplication operation can be easily converted into an addition operation by using the logarithm function; therefore:

$$\ln(1 - |w|) = \ln(1 - |v|) + \ln(1 - |u|)$$

Radial rapidity can then be defined as:

$$R_r = \ln(1 - |v_r|)$$

Where v_r is the real observed relativistic radial speed, R_r is a virtual term can be dealt with in the same way as classical mechanics would deal with velocity i.e. Radial rapidities can be added together normally.

In order to get a positive value, radial rapidity should be defined as:

$$R_r = \ln\left(\frac{1}{1 - |v_r|}\right)$$

That serves the same purpose.

The vector formula will be:

$$\vec{R}_r = \ln\left(\frac{1}{1 - |v_r|}\right)\hat{v}_r$$

Where $\hat{v}_r$ is the unit vector on the same line and direction of $\vec{v}_r$.

Noticeably, a similar method is being used in musicology. For example, when stopping a *C* string at 1:4 of its total length, then, playing the string produces the *F* note. Again, when stopping the string at 1:3 of the remaining length, playing the string produces the next *C* note. We have:

$$\frac{1}{4} + \frac{1}{3}\left(1 - \frac{1}{4}\right) = \frac{1}{4} + \frac{1}{3} - \frac{1}{4} \times \frac{1}{3} = \frac{1}{2}$$

Where 1:2 is the ratio of length that should be stopped on a *C* string in order to get the pitch of the next *C* note.

The known interval ratio (ratio of frequencies) law is:

$$ir = \frac{1}{1 - |sr|}$$

Where *ir* is the interval ratio and *sr* is the string ratio. For example, the string ratio between C and F is 1:4, and then the interval ratio between *C* and *F* is 4:3, meaning the sonic frequency of the note *F* equals 4:3 the sonic frequency of the note *C*.

Two interval ratios can be multiplied to get a third interval ratio:

$$\left(\frac{1}{1-\frac{1}{4}}\right) \times \left(\frac{1}{1-\frac{1}{3}}\right) = \left(\frac{1}{1-\frac{1}{2}}\right) \Leftrightarrow$$
$$\frac{4}{3} \times \frac{3}{2} = \frac{2}{1}$$

Where 4:3 is the interval ratio between *C* and *F*, 3:2 is the interval ratio between *F* and next *C* and 2:1 is the interval between *C* and the next *C*.

However, in the daily practice of music, interval multiplication is not used; rather, interval addition is, since music intervals are calculated using logarithms to convert the difficult process of multiplication to addition:

$$\ln\left(\frac{1}{1-\frac{1}{4}}\right) + \ln\left(\frac{1}{1-\frac{1}{3}}\right) = \ln\left(\frac{1}{1-\frac{1}{2}}\right) \Leftrightarrow$$
$$\ln\left(\frac{4}{3}\right) + \ln\left(\frac{3}{2}\right) = \ln(\frac{2}{1})$$

Because an octave has 12 semitones, the above equation can be multiplied by $12/\ln(2)$:

$$\ln\left(\frac{4}{3}\right) \times 12/\ln(2) + \ln\left(\frac{3}{2}\right) \times 12/\ln(2) = \ln\left(\frac{2}{1}\right) \times 12/\ln(2) \Rightarrow$$
$$5 + 7 = 12$$

Where 5 is the interval in semitones between *C* and *F*, 7 is the interval in semitones between *F* and the next *C*, and 12 is the interval in semitones between two consecutive *Cs* (one octave).

Taking such time to explain musical intervals addition is very beneficial, since it helps us to understand the relativistic addition law of the radial speeds and distinguish multiplicative amounts from additive ones.

Tangential speeds can be added in the traditional Euclidean way; however, a radial speed affects tangential speed in a relativistic way. For a velocity having two non-null components, radial and tangential, tangential rapidity can be obtained as:

$$\vec{v}_t = \vec{R}_t(1 - |v_r|) \Rightarrow$$
$$\vec{R}_t = \frac{\vec{v}_t}{(1 - |v_r|)}$$

Then:

$$
\begin{aligned}
&\vec{R} = \vec{R}_r + \vec{R}_t \Rightarrow \\
&R^2 = {R_r}^2 + {R_t}^2 \\
&= \ln^2\left(\frac{1}{1 - |v_r|}\right) + \frac{{v_t}^2}{(1 - |v_r|)^2}
\end{aligned}
$$

Rapidity is a very important principle because it greatly facilitates working with velocities and it obviates the need for the space-time principle. Velocities are the real observed and measured values, which are not additive, although it looks so with not very high speeds, while rapidity is a theoretical principle, and is additive.

3.3 *Time Dilation*

All speeds inside a moving system with relativistic speed, decrease for a relatively stationary observer. Since no theoretical principle requires or causes change in distance, the decrease in the speed indicates a corresponding decrease in time interval, making it appears as though there is time dilation inside a moving system with a relativistic speed. This does not mean that the time itself changes, but simply everything slows down, and every process then takes more time.

Special Relativity predicts both a decrease in distance (length contraction) and time dilation. However, a relativistic distance change has never been proven by experiments, while time dilation has. The extent of time dilation predicted by Special Relativity does not equal the extent predicted here; therefore, a dedicated experiment can compare Special Relativity with this time dilation reinterpretation.

3.4 *The Twin Paradox*

Whenever time dilation is discussed, the Twin Paradox appears, a thought experiment involving identical twins, one of them makes the high-speed journey into space in a high-speed and returns home, while the other one stays on the -assumed stationary- Earth. Because each twin sees the other twin as traveling, it can be falsely predicted that each of them would find that the other has aged more slowly.

Although the solution to this paradox is known, it is not well explained in most references.

Before traveling, both twins must be stationary, relative to Earth, in order to realign their watches to match. Remembering that the watches speeds should be matched in addition to their times.

Then, twin A stays on Earth, while twin B travels at a speed $|v|$ away from it. Evidently, acceleration is needed to launch B's spaceship; therefore, twin B cannot claim that his post-launching speed is null, since the velocity increases due to acceleration and his locally-known speed does not equal zero. A similar situation takes a place when twin B needs to return to Earth, and since he would experience acceleration again, the returning locally-known speed would be the same speed observed by twin A. This means the traveling twin B ages more slowly, and his watch delays; something both twins would realize.

3.5 *The Immense Rotating Disk*

Imagine a huge disk rotating with a noticeable fast angular speed, then, its points would be moving in an absolute tangential speed in a polar coordinate system centered at the center of the disc. Since the

tangential speed is the product of angular speed and distance from the rotation center, a question arises, could the tangential speed of the points on the far disk's edge, exceed the speed of light?

Theoretically, it could! Although practically it might not, as unfamiliar factors would be experienced, since the internal energy and mass of the parts on the disk's edge would be negative, and their gravitational force would be repulsive, as we will see.

4 Relativistic gravitation

4.1 *Newton's Universal Law of Gravitation*

Suppose an object *b* attracts an object *a* by its gravitational mass, and *b's* mass is very much bigger than *a's* that we can ignore *a's* mass effect on *b*. *r* is the variable distance between *a* and *b*, a_r the acceleration of *a*, and *G* the gravitational constant. Then, Newton's universal law of gravitation in polar coordinates centered at *b* is given as follows:

$$a_r = -G\frac{m}{r^2}$$

Note that, when expressing the universal law of gravitation using acceleration, without the use of the Newtonian Force principle, the mass of the attracted object does not count at all; thus, we do not care whether it equals zero, or infinity, or even negative. It would be a very common misconception to assume that the mass of the attracted object has some effect on its own acceleration and speed.

Why is acceleration inversely proportional to the squared distance ($a_r \propto \frac{1}{r^2}$)? The simplest explanation is acceleration is inversely proportional to the surface area of a sphere with radius *r*, since a sphere surface area is proportional to its squared radius.

The law of sphere surface area is given as:

$$A(r) = 4\pi r^2$$

And the Universal Law of Gravitation can be expressed as:

$$a_r = -4\pi G\frac{m}{4\pi r^2}$$

Then:

$$a_r = -4\pi G\frac{m}{A}$$

Defining $g = 4\pi G$, we get:

$$a_r = -g\frac{m}{A}$$

Therefore, acceleration does not decrease in respect to radial distance. Rather, it distributes over the sphere's surface.

4.2 ***Relativistic Universal Law of Gravitation***

The formula of acceleration in polar coordinates can be obtained as follows:

$$x = r\,cos(\theta) \Rightarrow$$
$$\dot{x} = \dot{r}\,cos(\theta) - r\,\dot{\theta}\,sin(\theta) \Rightarrow$$
$$\ddot{x} = \ddot{r}\,cos(\theta) - \dot{r}\,\dot{\theta}\,sin(\theta) - \dot{r}\,\dot{\theta}sin(\theta) - r\ddot{\theta}\,sin(\theta) - r\dot{\theta}^2\,cos(\theta) \Rightarrow$$
$$\ddot{x} = \left(\ddot{r} - r\dot{\theta}^2\right) cos(\theta) - \left(2\dot{r}\dot{\theta} + r\ddot{\theta}\right) sin(\theta)$$

Where the dot represents the first-order derivative in respect to time and the two dots represent the second-order derivative in respect to time.

When $\theta = 0$, $\ddot{x}$ represents radial acceleration a_r, and when $\theta = \frac{\pi}{2}$, $-\ddot{x}$ represents tangential acceleration a_t. Therefore:

$$a_r = \ddot{r} - r\dot{\theta}^2$$

$$a_t = 2\dot{r}\dot{\theta} + r\ddot{\theta}$$

Acceleration is defined as the rate at which velocity changes with time, however, mathematically this change is commonly calculated by subtracting the old velocity from the new. The change of an additive physical quantity may be calculated by subtraction, while non-additive ones may not.

As we have discovered, relativistic velocities are not additive i.e. two velocities may not be added to get a third velocity. On the contrary, rapidity is additive, and adding two rapidities may produce a third rapidity. Then, the corresponding relativistic velocities are added relativistically.

As regards the radial acceleration law concluded above, $\ddot{r}$ is replaceable by the first order derivative of radial rapidity in respect to time. In addition, the term $(r\dot{\theta}^2)$ equals $(v_t\dot{\theta})$ and the tangential velocity is replaceable by the tangential rapidity. Hence:

$$\begin{aligned} a_r &= \dot{R}_r - R_t\dot{\theta} \\ &= \frac{d\left(\ln\left(\frac{1}{1-|\dot{r}|}\right)\right)}{dt} - \frac{v_t}{1-|\dot{r}|}\dot{\theta} \\ &= \frac{\ddot{r}}{1-|\dot{r}|} - \frac{r\dot{\theta}^2}{1-|\dot{r}|} \end{aligned}$$

Note here that $\overrightarrow{R_r}$ has the same direction of $\overrightarrow{v_r}$; therefore, R_r equals $\left(\ln\left(\frac{1}{1-|\dot{r}|}\right)\right)$ when $\dot{r}$ has positive value and equals $\left(-\ln\left(\frac{1}{1-|\dot{r}|}\right)\right)$ when $\dot{r}$ has negative value; therefore, the function R_r is continuous and can be derived on the range $]-1,1[$, and $\dot{R}$ has the same sign of $\ddot{r}$.

Then the relativistic universal law of gravity is:

$$\frac{\ddot{r}}{1-|\dot{r}|} - \frac{r\dot{\theta}^2}{1-|\dot{r}|} = -G\frac{m}{r^2}$$

This formula applies for an observer placed at the center of gravitation.

For an observer placed at attracted object, let us firstly consider the case where $\dot{r}$ is initially null. In this case, any gained radial speed, due to acceleration, is noticeable by the observer as a locally-known speed, and the same equation above applies.

Secondly, when $\dot{r}$ has a value other than zero, assuming, for simplicity sake, that $\dot{r}$ does not change immediately after that, the relativistic universal law of gravitation for an observer on the attracted becomes:

$$\ddot{r} - r\dot{\theta}^2 = -G\frac{m(1 - |\dot{r}|)}{r^2} = -G\frac{m_I}{r^2}$$

Assuming that the gravitational mass is the internal mass that decreases upon speed of moving, toward or away from attracted object. Apparently, the equation above is the very same previous one, albeit written alternatively. Thus, the moment from which we start studying the case onward, or the location and speed of the observer, do not have any bearing on the result, and both gravitation and acceleration are affected by radial speed in the same way, which means that all equivalence principles are right.

It is noteworthy that the equation above complies very well with what we know well about the behavior of light near huge masses. For instance, a given mass does not cause a photon to accelerate, when moving toward, or away from it (since the gravitational mass becomes zero, for the photon). Moreover, when $|\dot{r}| \ll 1$, the equation becomes very much alike the Newtonian equation, which implies that when the photon's velocity is not purely radial relative to mass, its path shall curve.

In the context of General Relativity, Einstein introduced the concept of curvature of space-time, which has been considered widely as an explanation of gravity. A theoretical explanation needs to be simpler, more intuitive, or more general (i.e. more than one other phenomenon, or physical law can be concluded from it) than the explained phenomenon, but none of these conditions apply, if we try to consider the curvature of space-time, as an explanation of gravity. It is not simpler, does not explain more than one phenomenon, nor is it more intuitive, since if you ask yourself how mass causes the curvature of space-time, the first thing that hits you is that there is some kind of force that forces space-time to curve.

Furthermore, the main postulate in Einstein's theories is that any speed, including the speed of gravity, may not exceed the speed of light. On the contrary, here, the constant speed of light is just a result that only applies to objects in motion, thus, gravity needs not to travel in the speed of light i.e. its effect is instant, as the masses move.

Apparently, the curvatures of space-time, or the space-time principle, are not needed to explain relativistic phenomena, while very much simpler assumptions can do the trick.

5 Orbits

5.1 *The Relativistic Orbits Equation*

Next, we will use a geometric unit system, where *G* = 1.

As we assume here, the gravitational acceleration in polar coordinates centered at center of gravity, is purely radial, meaning the tangential acceleration is null:

$$a_t = 2\dot{r}\dot{\theta} + r\ddot{\theta} = 0 \Rightarrow$$

$$2r\dot{r}\dot{\theta} + r^2\ddot{\theta} = 0 \Rightarrow$$

$$\frac{\mathrm{d}(r^2\dot{\theta})}{\mathrm{d}t} = 0$$

Therefore, the quantity $h = r^2\dot{\theta}$ is constant in respect to time.

Let $u = \frac{1}{r} \Rightarrow$

$$\frac{1}{u^2} = \frac{h}{\dot{\theta}} \quad (1)$$

$$\dot{r} = \frac{d\left(\frac{1}{u}\right)}{dt} = -\frac{\dot{u}}{u^2} = -h\frac{\dot{u}}{\dot{\theta}} = -h\frac{du}{dt}.\frac{dt}{d\theta} = -h\frac{du}{d\theta} \quad (2)$$

$$\Rightarrow \ddot{r} = -h\frac{d\left(\frac{du}{d\theta}\right)}{dt} = -h\frac{d\left(\frac{du}{d\theta}\right)}{d\theta}.\frac{d\theta}{dt} = -h\frac{d^2u}{d\theta^2}.\dot{\theta}$$

By substituting (1), it follows that:

$$\ddot{r} = -h^2u^2\frac{d^2u}{d\theta^2} \quad (3)$$

As we conclude here, the relativistic universal law of gravitation can be written in a similar formula as the Newtonian equation, considering the attractive mass is the variable internal mass:

$$\ddot{r} - r\dot{\theta}^2 = -\frac{m(1 - |\dot{r}|)}{r^2} = -\frac{m_I}{r^2}$$

Still, we will apply Newtonian formula firstly by considering m_I constant, giving it the symbol *m*, because this would help analyze the new equations by comparing them to the well-understood and analyzed ones:

$$\ddot{r} - r\dot{\theta}^2 = -\frac{m}{r^2} \quad (4)$$

By substituting (2) and (3) in (4) and using $\frac{1}{u}$ instead of r, we get:

$$-h^2u^2\frac{d^2u}{d\theta^2} - \frac{(hu^2)^2}{u} = -mu^2$$

By dividing by $-u^2h^2$ we get:

$$\frac{d^2u}{d\theta^2} + u = \frac{m}{h^2}$$

This is a second-order linear ordinary differential equation, whose known solution is:

$$u = c_1\,cos(\theta) + \frac{m}{h^2}$$

Making $L = \frac{m}{h^2}$ we get:

$$u = (u_0 - L)\, cos(\theta) + L$$

Reverting to use r, we get:

$$r = \frac{\frac{1}{L}}{\left(\frac{1}{Lr_0} - 1\right) cos(\theta) + 1}$$

This is the equation of a conic section, which is an ellipse, hyperbola, or parabola, based on the value of the eccentricity parameter $\varepsilon = \left(\frac{1}{Lr_0} - 1\right) = \left(\frac{h^2}{mr_0} - 1\right)$, producing those forms, when the eccentricity is less than, greater than or equal to 1, respectively.

Now, considering that m_I is in fact variable:

$$\ddot{r} - r\dot{\theta}^2 = -\frac{m(1 - |\dot{r}|)}{r^2} \quad (5)$$

When using the absolute value of $\dot{r}$, we have two different cases:

1- $\dot{r} > 0 \Rightarrow m_I = m(1 - \dot{r}) \Rightarrow \ddot{r} - r\dot{\theta}^2 = -\frac{m(1-\dot{r})}{r^2}$
2- $\dot{r} < 0 \Rightarrow m_I = m(1 + \dot{r}) \Rightarrow \ddot{r} - r\dot{\theta}^2 = -\frac{m(1+\dot{r})}{r^2}$

By substituting (2) and (3) and using $\frac{1}{u}$ instead of r in the first case, the differential equation becomes:

$$\frac{d^2u}{d\theta^2} + u = \frac{m\left(1 + h\frac{du}{d\theta}\right)}{h^2} \Rightarrow$$
$$\frac{d^2u}{d\theta^2} + u = \frac{m}{h^2} + \frac{m}{h}.\frac{du}{d\theta}$$

It is also a second-order linear ordinary differential equation. Bu using a software application, I get a solution:

$$u = c_1 e^{\frac{1}{2}\left(\frac{m}{h} - \sqrt{\left(\frac{m}{h}\right)^2 - 4}\right)\theta} + c_2 e^{\frac{1}{2}\left(\frac{m}{h} + \sqrt{\left(\frac{m}{h}\right)^2 - 4}\right)\theta} + \frac{m}{h^2}$$

Let $L = \frac{m}{h^2}, L_2 = \frac{m}{2h}$ then:

$$u = e^{L_2\theta}\left[c_1 e^{-\sqrt{L_2{}^2 - 1}\,\theta} + c_2 e^{\sqrt{L_2{}^2 - 1}\,\theta}\right] + L$$

For the majority of orbiting objects, $m \ll h$, hence, $L_2{}^2 \ll 1$, then:

$$u = e^{L_2\theta}\left[c_1 e^{-i\sqrt{1 - L_2{}^2}\,\theta} + c_2 e^{i\sqrt{1 - L_2{}^2}\,\theta}\right] + L$$

It follows that u is a real value, only when $c_1 = c_2$. Defining $c_3 = 2c_1 = 2c_2$, we get:

$$u = c_3 e^{L_2\theta}\left[\frac{e^{-i\sqrt{1-L_2{}^2}\,\theta} + e^{i\sqrt{1-L_2{}^2}\,\theta}}{2}\right] + L \Rightarrow$$

$$u = c_3 e^{L_2\theta}\, cos\left(\sqrt{1-L_2{}^2}\,\theta\right) + L \Rightarrow$$

$$u = (u_0 - L)e^{L_2\theta}\, cos\left(\sqrt{1-L_2{}^2}\,\theta\right) + L$$

If $m > 2h \Leftrightarrow L_2 > 1$, then the term inside the cosine function becomes $\left(\sqrt{L_2{}^2-1}\,\theta\right)$.

Where $\dot{r} < 0$ in the second case, only the sign of L_2 changes, then, the equation of orbital movement becomes:

$$u = (u_0 - L)e^{-L_2\theta}\, cos\left(\sqrt{1-L_2{}^2}\,\theta\right) + L$$

Reverting to the use of r, instead of $u = \frac{1}{r}$, we get the following two equations:

$$\dot{r} > 0 \Rightarrow$$

$$r_1 = \frac{\frac{1}{L}}{\left(\frac{1}{Lr_0} - 1\right)e^{L_2\theta}\, cos\left(\sqrt{1-L_2{}^2}\,\theta\right) + 1}$$

$$\dot{r} < 0 \Rightarrow$$

$$r_2 = \frac{\frac{1}{L}}{\left(\frac{1}{Lr_0} - 1\right)e^{-L_2\theta}\, cos\left(\sqrt{1-L_2{}^2}\,\theta\right) + 1}$$

These equations are not very different from that of the orbits from the Newtonian universal law of gravity. In fact, only two differences appear:

1- The angle θ inside the cosine function is multiplied by the factor $\sqrt{1-L_2{}^2}$, meaning the period of the cosine amount does not equal 2π, but rather, $\frac{2\pi}{\sqrt{1-L_2{}^2}}$; therefore, in the case of a barely elliptical orbit, the orbit rotates in every cycle by a very small degree in the same angular direction of orbiting.
2- When $\dot{r} > 0$, and the orbiting object is moving away from the center of gravity, eccentricity $\left(\frac{1}{Lr_0} - 1\right)$ is multiplied by $e^{L_2\theta}$; and when $\dot{r} < 0$, and the orbiting object is moving toward the center

of gravity, eccentricity is multiplied by $e^{-L_2\theta}$. This means that the eccentricity of an orbit increases then decreases geometrically in every orbiting cycle. Therefore, for a barely elliptical orbit, the shape is akin to a chicken egg i.e. one of its heads is flatter than the other one.

However, the difference between Newtonian orbits and relativistic orbits, as introduced here, is so tiny and it is very hard to observe. Other factors e.g. the gravities of other planets, or tidal forces, usually have a greater observed impact on planets' orbits.

5.2 *Perihelion and Aphelion*

In a barely elliptical orbit, Perihelion is the point of the nearest distance, and Aphelion is the point of farthest distance.

Next, we are going to use the function *u*, instead of *r*, to facilitate the process.

When $\dot{r} > 0$, the symbol u_1 is used for *u*, and r_1 for *r*; thus, the orbital equation becomes:

$$u_1(\theta) = (u_0 - L)e^{L_2\theta}\cos\left(\sqrt{1 - {L_2}^2}\,\theta\right) + L$$

Let $L_3 = \sqrt{1 - {L_2}^2}$, Then:

$$\acute{u}_1(\theta) = (u_0 - L)e^{L_2\theta}(L_2\cos(L_3\,\theta) - L_3\sin(L_3\,\theta))$$

$e^{L_2\theta}$ may not be null, nor $(u_0 - L)$ may be, unless the orbit is a perfect circle. Otherwise:

$$\begin{aligned}
&\acute{u}_1 = 0 \Rightarrow \\
&L_2\cos(L_3\,\theta) - L_3\sin(L_3\,\theta) = 0 \Rightarrow \\
&L_2\cos(L_3\,\theta) = L_3\sin(L_3\,\theta) \Rightarrow \\
&\frac{L_2}{L_3} = \tan(L_3\,\theta + \pi k) \Rightarrow \\
&\theta_{1,k} = \frac{1}{L_3}(\mathrm{atan}\left(\frac{L_2}{L_3}\right) + \pi k)
\end{aligned}$$

Where k is an integer, $\theta_{1,k}$ are the roots of $\acute{u}_1$.

When $\dot{r} < 0$, u_2 is used for *u*, and r_2 for *r*, the calculation becomes:

$$u_2(\theta) = (u_0 - L)e^{-L_2\theta}\cos(L_3\,\theta) + L$$

Then:

$$\acute{u}_2(\theta) = (u_0 - L)e^{-L_2\theta}(-L_2\cos(L_3\,\theta) - L_3\sin(L_3\,\theta))$$

With similar steps to the case of u_1, we get:

$$\theta_{2,k} = \frac{1}{L_3}(-\mathrm{atan}\left(\frac{L_2}{L_3}\right) + \pi k)$$

Where $\theta_{2,k}$ are the roots of $\acute{u}_2$.

It seems, the roots of $\acute{u}_1$ do not match those of $\acute{u}_2$; in fact, they are the same, since when u_1 is applicable $\left(\acute{r} > 0 \Leftrightarrow \acute{u} < 0\right)$ and reaches a root of $\acute{u}_1$, then $\acute{u}$ becomes larger than zero, and $\acute{r}$ less than zero, and u_2 becomes the function being applied, starting with a $\acute{u}_2$ root.

For a barely elliptical orbit, the roots $\theta_{1,k}$, or the identical $\theta_{2,k}$, are the points of perihelion and aphelion. Even so, eccentricity increases, then decreases in every cycle, the extent of perihelion and aphelion (least and greatest distance from the center of gravity) stays the same, since, in every cycle, the increase in eccentricity, when the function r_1 (u_1) applies, is cancelled totally by the decrease in eccentricity, when r_2 (u_2) applies.

It is noteworthy that the power of the value $e^{L_2\theta}$ in the function u_1 or the value $e^{-L_2\theta}$ in the function u_2 may not be substituted simply by the value of θ, but with the value of $(\theta - \theta_0)$, where θ_0 is the last angle reached, when the other function is applied.

The amount of perihelion, then, is the result we get by substituting $\theta_{1,0}$ in the equation of r_1 (or the equal result we get by substituting $\theta_{2,0}$ in the equation of r_2), that we will call r_{00}, the value of which can be calculated the following way:

$$r_{00} = \frac{1}{\left(\frac{1}{r_0} - L\right) e^{\frac{L_2}{L_3}\operatorname{atan}\left(\frac{L_2}{L_3}\right)} \cos\left(\operatorname{atan}\left(\frac{L_2}{L_3}\right)\right) + L}$$
$$= \frac{1}{\left(\frac{1}{r_0} - L\right) L_3 e^{\frac{L_2}{L_3}\operatorname{atan}\left(\frac{L_2}{L_3}\right)} + L}$$

Where r_{00} is the real observed perihelion, knowing the difference between r_0 and r_{00} is minute.

5.3 *Perihelion Procession*

Perihelion Procession is the term describing the rotation of an orbit. As mentioned above –and whether u_1 or u_2 applies-, there will be a steady, easily calculable rotating factor:

$$\Delta\varphi = \frac{2\pi}{L_3} - 2\pi = 2\pi\left[\frac{1}{\sqrt{1 - \left(\frac{Gm}{2hc}\right)^2}} - 1\right]$$

6 A Comparison with the Tests Done on General Relativity

6.1 *Mercury Perihelion Procession*

The Mercury perihelion procession phenomenon was the first test considered a proof of General Relativity.

Almost every solar planet's orbit rotates a little every cycle. While a large amount of that procession can be considered as an effect of other planets' gravities, a small amount remains unexplained by the Newtonian Universal Law of Gravity. A case in point is Mercury's perihelion, which was the most studied, since its orbital eccentricity is large enough to be observed accurately, and some scientists thought that an unknown planet orbiting between the Sun and Mercury causes that additional procession. However, such a planet did not exist.

The additional procession, as observed and calculated at the turn of the 20^{th} century, was 48`` every century. The calculations, based on General Relativity, predict the very same value, and then considered a good proof of General Relativity.

Using our new equations of orbits, the amount of procession, as previously mentioned becomes:

$$\Delta\varphi = 2\pi\left[\frac{1}{\sqrt{1-\left(\frac{Gm}{2hc}\right)^2}}-1\right] \approx 2\pi\left(1+\frac{1}{2}\left(\frac{Gm}{2hc}\right)^2-1\right)=\frac{\pi}{4}\left(\frac{Gm}{hc}\right)^2$$

In the case of Mercury, by substituting values obtained from the NASA web site, perihelion procession is:

$$\Delta\varphi \approx \frac{\pi}{4}\left(\frac{132{,}712{,}000{,}000}{2{,}713{,}080{,}000 \times 299{,}792.458}\right)^2 \approx 2.09E^{-8}$$

This value is in radian. Since Mercury orbits 415 times every Earth century, then the perihelion procession of Mercury in seconds of arc would equal:

$$2.09E^{-8} \times 415 \times 360 \times 3600 \div (2\pi) \approx 1.79``$$

This amount is about 1/24 of the procession amount predicted by General Relativity, considered consistent with observations.

Does General Relativity win the argument? Not necessarily.

Today, new calculations and observations using additional factors give a different result than was accepted then. For instance, according to Smulsky (2011), the additional perihelion procession equals, 0.53``, every 100 Earth years, an indication that our prediction is more accurate than Einstein's.

6.2 *Light Bending Near the Sun*

Another more famous test of General Relativity was the measurement of the light bending extent near the Sun.

General Relativity predicts light bends near a mass, when its path is not purely radial. Measuring the bending light from distant stars, near the mass of the Sun, seems an easy test. Yet, it can be done only during a total eclipse, when the effect of solar light may be omitted.

When studying the path of light and the movement of photons, the use of Newtonian mechanics would be irrelevant, as it predicts that a photon accelerates, as any other slower body does, contradicting reality. However, the calculations of light bending, based on Newtonian mechanics can be useful, as a basis for comparison.

Approximate calculations based on Newtonian mechanics equations predict that the bending light angle near a mass equals:

$$\delta_{Newtonian} \approx 2\frac{m}{r_0}$$

When using a unit system, where *c = 1*, *G = 1* and angle is in radian (Brown, 2011).

In the case of light bending near the Sun, the mass of the Sun, in used units, is about *m* = 1475, and a beam of light distance from the Sun's center is equal to the Sun's radius, r_0 = 6.95×10^8; therefore, the Newtonian prediction would be, 0.000004245 radians, which equals 0.875 seconds of arc (Brown).

In 1915, Einstein gave a different prediction based on his General Relativity, which doubles Newtonian:

$$\delta_{Einsteinian} \approx 4\frac{m}{r_0}$$

This is about 1.75`` seconds of arc in this case (Brown).

In 1919, in the aftermath of the First World War, scientific expeditions were sent to Sobral in South America and Principe in West Africa to make observations of the solar eclipse. The reported results comply with Einstein's predictions. This was taken as a fundamental proof of General Relativity (Brown).

Complicated calculations are not needed to determine the degree of the bending of light, based on the equations mentioned in this new research, since the use of datasheet software application would yield an accurate result.

In the case studied here, upon new equations, the bending angle is about 0.875 seconds of arc, a bit larger than the bending angle upon Newtonian's, where its accurate value is 0.873 seconds of arc.

This means, based on the new orbit equations introduced here, prediction approximates the prediction based on Newtonian's Mechanics, rather than General Relativity.

Does General Relativity win the argument? Again, not necessarily.

Many references contend that all the later experiments on the bending of the light near the Sun confirm the experiment of 1919, which complies with the prediction of General Relativity. They do not! In fact, certain tests yield a noticeably larger value for the bending of light that don't comply with Einstein's predictions, as in Sumatra on 9 May, 1929, where the reported result is 2.24 ± 0.01 and in the USSR on 19 June, 1936, where the reported result is 2.73 ± 0.31 (Brown).

It seems, another factor affects the results, in addition to gravitation. In fact, a very strong candidate is already known i.e. light refraction caused by gases in the Sun's atmosphere (neutral gas, not plasma). According to Xu (2002), the light refraction by the Sun's atmosphere can deflect a starlight ray, touching the solar limb by 26``, a value 15 times larger than the gravitational bending predicted by General Relativity, and 30 times than the gravitational bending predicted in this paper. This value decreases very rapidly when the light ray passes farther away from the edge of the Sun. For instance, when this distance is 460 kilometers,

the deflection would be roughly 0.8``, thus, any observation would yield 1.75`` in this precise distance, thereby confirming this theory, rather than General Relativity.

700 kilometers farther away from the limb, this deflection becomes very insignificant. Measurements made in 1919, 1922 and 1929 demonstrate that, in the range between 0.5 to 5 solar radii above the Sun's edge, the results are noticeably greater than any theoretically-predicted value, including the sum of General Relativity's gravitational deflection and the deflection from gas refraction. Above that distance, the measurement results become very chaotic (Freundlich, Klüber and Brunn, 1931).

Therefore, it is clear that some hitherto uncounted factor has an impact; perhaps, it is the gas refraction, where the temperature is very high in the solar corona. That said, there is a clear difference between the measurements and all known theories, and measurements may not be taken, as a confirmation of any gravitational theory, unless light refraction and any other possible factors have accurately been calculated.

7 Conclusion

Considering the energy-mass equation $E = mc^2$, as a main postulate, and giving a very intuitively acceptable definition of energy, all the relativistic phenomena, such as the constant speed of light and other ones predicted by Special or General Relativity, can be readily explained. In addition, newly predicted values of the Mercury perihelion procession, as well as the degree of the bending of light near the Sun, are not necessarily worse than the values predicted in General Relativity regarding accuracy with experiment results.

I cannot compare the results herein predicted with those of all the experiments done to test other relativity theories. In fact, I should not. Tests made by other physicists, dedicated to comparing this theory with the Special and General Relativity could add more credibility and confirm my study.

Another important factor, to be considered when evaluating this study, is its compatibility with other widely accepted theories, especially Quantum Mechanics, something I am not qualified to accomplish.

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